Report of the Black Water Task Force

April 2005

Kentucky
UNBRIDLED SPIRIT

Environmental and Public Protection Cabinet

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Members of the Black Water Task Force and others who contributed to this report on an evaporated slurry pond at the Shamrock Coal Company. From left to right: Bill Caylor, Judy Petersen, Lloyd Cress, Don Bowles, Secretary Wilcher, Lindell Ormsbee, Jean Dorton, Dan Geiger, an unidentified company official and Susan Bush. Photo courtesy of the Environmental and Public Protection Cabinet.

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On the cover: The background image is one view from the Blanton Forest State Nature Preserve in Harlan County. The inset photos are two sites that were cleaned after the 2000 Martin County Coal Corporation Slurry Spill. Photos courtesy of the Environmental and Public Protection Cabinet.

Executive Summary

Black water spills can foul miles of Kentucky waterways, adversely affect aquatic life and habitat and temporarily disrupt or contaminate public water systems. Seventeen black water spills were confirmed in Kentucky in 2003 and 18 in 2004.

Guided by his intent to minimize the occurrence of black water spills in Kentucky, Governor Ernie Fletcher authorized Kentucky Environmental and Public Protection Cabinet Secretary LaJuana S. Wilcher to create the Black Water Task Force. Secretary Wilcher appointed a task force with members that represent a range of views of the issues associated with black water spills.

Members of the task force represent large and small coal companies in eastern and western Kentucky, academic institutions, environmental organizations and government agencies. Task force members include coal preparation plant managers, biologists, physicists, engineers and lawyers. Secretary Wilcher and the following individuals are members of the task force: Don Bowles, Charolais Coal; Bill Caylor, Kentucky Coal Association; Tom FitzGerald, Kentucky Resources Council; Dr. Lindell Ormsbee, Kentucky Water Resources Research Institute and Environmental Quality Commission; Judy Petersen, Kentucky Waterways Alliance; and Bruce Short, Argus Energy. Additionally, David Lamb, Associated Engineers, Inc.; Dan Geiger of Lexington Coal Company, LLC; Susan Bush, Commissioner of the Department for Natural Resources; and Lloyd Cress, Commissioner of the Department for Environmental Protection, served as advisors to the task force by attending meetings and offering their expertise.

The task force was announced on January 12, 2004. The mission of the Black Water Task Force was to address black water spills in Kentucky. To accomplish this mission, Secretary Wilcher invited the members of the task force to examine the causes of black water spills and their impact on aquatic resources and human health. The members also participated in the development of recommendations for the coal industry aimed at minimizing the frequency and severity of black water discharges.

To date, the Black Water Task Force has met 17 times. During these meetings, scientific and management professionals from the Environmental and Public Protection Cabinet have given presentations on a variety of topics, including historic trends of water quality violations, effects of spills on stream ecology, potential toxicity of black water from heavy metals and organic compounds, causation, and best management practices (BMPs) for minimizing occurrences of black water spills. The task force toured and examined coal preparation plants and slurry impoundments. The visits aided task force members in reaching a consensus on BMPs for mining operations and coal preparation plants.

At the request of the Governor, the task force has developed an action plan to address black water spills in Kentucky. The BMPs and other recommendations in this report are practical, preventive measures that coal operators can employ to minimize, reduce or eliminate occurrences of black water spills for little cost to the company. It is the recommendation of the task force to require the use of these BMPs in all areas of coal production. By taking this action, the task force hopes to minimize the number and severity of spills in an effective, reasonable manner and without the need for more regulations and laws.

The task force relied on scientific evidence from a variety of sources. Much of the data, however, was collected as a result of the 2000 Martin County Coal Corporation Slurry Spill. The data collected after this environmental disaster represents the most comprehensive information currently available for evaluating conditions associated with a major black water spill in Kentucky. The general conclusions of this report are largely based on the assumption that characteristics of the slurry and associated water samples of this spill represent the “worst-case scenario” of black water spills and therefore offer a conservative analysis of other black water events.[1]

Public awareness of the damages associated with black water spills was height-

[1] Since the Martin County Coal Corporation Slurry Spill has the most complete dataset to date, it is the source of many conclusions regarding health effects of black water releases. Black water spills may share some common characteristics, but vary in nature due to magnitude and concentration of coal fines in the spills.

ened after the Martin County Coal Corporation Slurry Spill, in which approximately 250 million gallons of coal slurry escaped from the Big Branch slurry impoundment near Inez, Ky. The Martin County Coal Corporation spill temporarily disrupted public water systems in Kentucky and West Virginia, eliminated aquatic life and caused an environmental calamity. A catastrophic spill, such as the 2000 Martin County Coal Corporation slurry disaster, can cost millions of dollars to clean up.

The Black Water Task Force evaluated potential human health and ecological effects and effects on habitat that can be a result of a black water spill. The task force discovered that when slurry samples from the Martin County Coal Corporation Slurry Spill were initially compared to background conditions, concentrations of metals in slurry were similar to mean values in soils in Kentucky. When compared to the range of background soils, the range of maximum values observed of metals in slurry were within the range of typical metal values in Kentucky soils. Concentrations of metals in slurry, however, are higher than values typically observed in stream sediment in eastern Kentucky.

The Black Water Task Force also concluded that chronic health effects from black water spills are not anticipated. However, initial effects on animals and plants due to habitat destruction and smothering are proportionate to the magnitude of the release. Impact to humans, depending on the size of the release, can be the loss of drinking water sources and property damage.

Health effects are expected to be no higher than those from typical exposure to soils in Kentucky because of the similarity between the metals in slurry samples and ambient soil and sediment levels. Also, any accumulation in tissues of aquatic organisms, including fish, due to this spill would likely be no different from uptake from stream sediments. The primary effect of black water spills on the environment include the smothering of organisms through interference with the gill surface and habitat destruction.

The Black Water Task Force also reviewed the enforcement procedures used by Kentucky regulatory agencies. During the review, it was discovered that the Division of

Mine Reclamation and Enforcement was not following the same enforcement procedure as the Division of Water regarding Discharge Monitoring Reports that indicated that one or more water quality standards had been exceeded during the reporting period. The task force recommended that the Division of Mine Reclamation and Enforcement change its enforcement procedure to parallel that of the Division of Water. Both agencies are now working together to develop a procedure that will implement the task force's recommendation.

The Black Water Task Force carefully reviewed all of the enforcement mechanisms currently employed by the Division of Mine Reclamation and Enforcement and Division of Water used to detect black water spills. (The Division of Mine Reclamation and Enforcement and the Division of Water are the two agencies with primary responsibility to respond to reports of black water spills.) Upon the recommendation of the Black Water Task Force, an internal procedure was developed to allow the agencies to coordinate the response to a report of a black water spill. Both agencies have now developed a joint protocol for coordinating their response to black water spills and taking appropriate enforcement action. This has improved the ability of both agencies to respond efficiently and effectively and to identify the source of the black water spill.

Overall, the Black Water Task Force worked diligently to find consensus for this list of BMPs and recommendations. Its overarching goal is to minimize the number and severity of black water spills. Implementation of these measures – while creating some additional capital or other direct costs – will lower risks of releases and reduce long-term costs by avoiding or minimizing the cost for remediation of natural resource damage and compensation for property damage and personal injury from releases and spills. To this end, the implementation of these BMPs is an opportunity for the coal industry to truly make a difference.

Background on Kentucky's Coalfields

The bituminous coal mined in western and eastern Kentucky was formed between 290 million and 325 million years ago. The western coalfield is part of the Illinois Basin, which covers most of Illinois and western Indiana. The eastern coalfield lies in the Appalachian Basin, a diagonal swath of land from Pennsylvania to Alabama.

The topography of Kentucky's coalfields differs. The western field is comprised of rolling hills and expanses of flat ground. Coal preparation plants and waste disposal facilities in this area are often constructed on sites that allow storm water management facilities to be designed with small embankments for coal waste disposal. Few black water spills occur in western Kentucky because embankments are small and excavations of coal seams are below base drainage flow. Also, coal waste deposited in underground mine works or pits have little or no potential of causing black water discharges. Due to the low gradient of the terrain, black water spills travel much more slowly and are more easily contained and managed than spills in eastern Kentucky.

The eastern field is characterized by steep slopes and narrow valleys. This topography creates concentrated drainage paths for coal preparation facilities and limits land suitable for development. In this area, coal processing and waste disposal facilities are built on small, mountainous parcels of land. To impound coal waste, significant and steep embankment structures are sometimes used to sift and dispose of coal waste. Also, many recoverable coal seams in this area are above the base flow of drainage in the area. Therefore, water and coal waste introduced into old works in these seams or kept in above-ground impoundments have, under certain conditions, the potential to drain into waterways in the area and become black water spills. Due to these conditions and fast-moving streams in the area, even small releases of black water rapidly travel down drainage and become noticeable downstream.

Section One: Background on Governor Fletcher's Black Water Task Force

Black water spills result from discharges of a mixture of water and fine coal refuse called slurry that can remain in suspension for significant periods of time. These discharges generally occur at coal preparation plants where coal is washed with large volumes of water to remove impurities. Black water discharges can also sporadically occur at deep mines, haul roads and combination mining operations.

When coal slurry is discharged into Kentucky's streams, a plume of black water can often be observed for miles downstream of the discharge point. These discharges are referred to as black water spills, and they can occur from coal slurry impoundments, slurry pipelines, sediment ponds, run off from improperly maintained roads or other coal mining-related activities.

Black water spills can foul miles of Kentucky waterways, adversely affect aquatic life and habitat and temporarily disrupt or contaminate public water systems. Public awareness of the damages associated with black water spills was heightened after the Martin County Coal Corporation Slurry Spill, in which approximately 250 million gallons of coal slurry escaped from the Big Branch slurry impoundment near Inez, Ky. The Martin County Coal Corporation spill temporarily disrupted public water systems in Kentucky and West Virginia, eliminated aquatic life and caused an environmental calamity. A catastrophic spill, such as the 2000 Martin County Coal Corporation slurry disaster, can cost millions of dollars to clean up.

The data collected as a result of the Martin County Coal Corporation Slurry Spill represents the most comprehensive information currently available for evaluating conditions associated with a major black water spill in Kentucky. The general conclusions of this report are largely based on the assumption that characteristics of the slurry and associated water samples of this spill represent the "worst-case scenario" of black water spills and therefore offer a conservative analysis of other black water events.[1]

[1] Since the Martin County Coal Corporation Slurry Spill has the most complete dataset to date, it is the source of many conclusions regarding health effects of black water releases. Black water spills may share some common characteristics, but vary in nature due to magnitude and concentration of coal fines in the spills.

Seventeen black water spills were confirmed in Kentucky in 2003 and 18 in 2004. These spills were significantly smaller than the Martin County Coal Corporation Slurry Spill in terms of environmental damage and cleanup costs. However, the number of spills in Kentucky in 2003 and in 2004 is a cause for concern.

Guided by his intent to minimize the occurrence of black water spills in Kentucky, Governor Ernie Fletcher authorized Kentucky Environmental and Public Protection Cabinet Secretary LaJuana S. Wilcher to create the Black Water Task Force. The mission of the Black Water Task Force is to address black water spills in Kentucky. Secretary Wilcher invited the members of the task force to examine the causes of black water spills and their impact on aquatic resources and human health. The members also participated in the development of recommendations for the coal industry aimed at minimizing the frequency and severity of black water discharges. The task force was announced on January 12, 2004.

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ing meetings and offering their expertise. Jean Dorton, former Executive Director of the Environmental and Public Protection Cabinet's (EPPC) Office of Legislative and Intergovernmental Affairs coordinated task force meetings and presentations. Dana Norton, an EPPC public information officer, helped draft, edit and produce this report. Contributors to the writing of the report include the following Department for Environmental Protection personnel: David Morgan, Division of Water; Larry Taylor, Commissioner's Office; Aaron Keatley, Division of Compliance Assistance; Tom VanArsdall, Division of Water; and Department for Natural Resources personnel Allen Luttrell, Commissioner's Office.

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Section Two: Definition of Black Water and Spill Causes

Definition of Black Water:

- Black water spills are one kind of substandard discharge that can occur at mining operations.

The National Academy of Sciences defines black water as “water mixed with fine coal refuse,” which is generally composed of fine coal, rock and clay particles with trace amounts of flocculants used to clarify the water that washes the coal. Black water is typically used to describe a substandard water discharge containing coal-processing waste or coal particles in high enough concentrations to discolor a stream. Spills can range from water with high turbidity to a release of a thick, semi-solid material.

Causes of Black Water Spills:

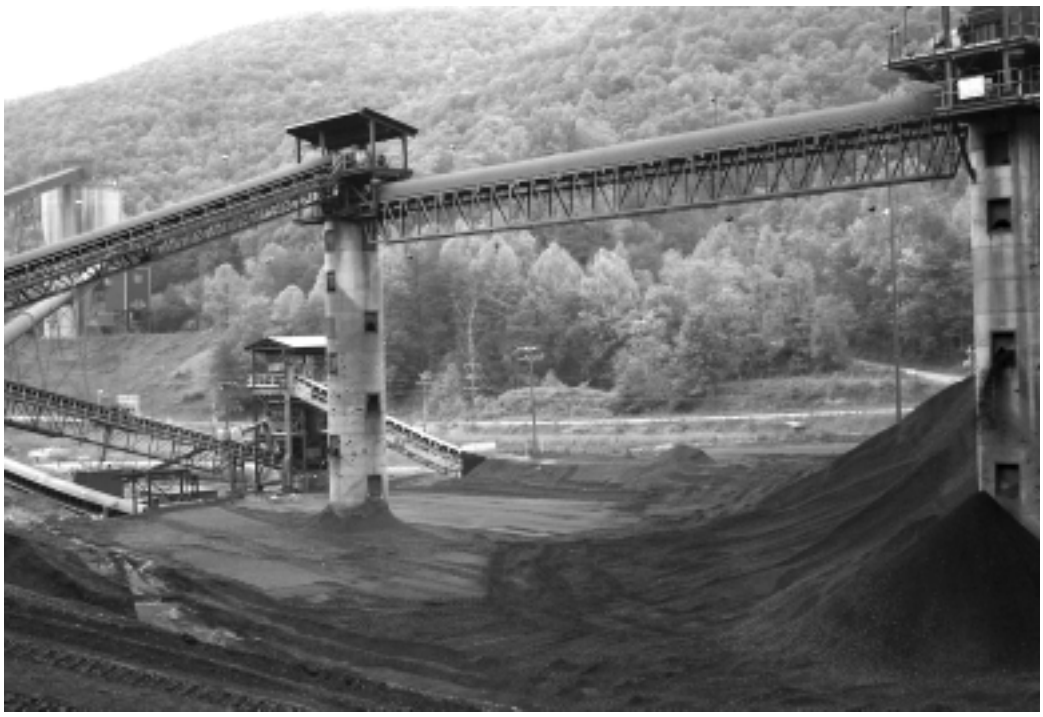
- The three most common causes of black water spills are operational errors, lack of proper maintenance, and intentional releases.

Operational error, which can include catastrophic equipment failure, is the largest contributor to spills and discharges. These errors can be caused by carelessness, failure to follow proper procedures and insufficient employee training. Examples of operational errors include pipelines damaged by heavy equipment or excessive wear, damage to riser pipes in sediment ponds, disturbance during pond cleaning activities, or pumping water into a pond that exceeds its design capacity. The most significant reduction in spills and releases caused by operational error can be obtained by incorporating and adhering to reasonable best management practices.

Lack of proper maintenance is another cause of substandard discharges. For example, many spills occur when sediment ponds are not cleaned out and ditches are not

maintained routinely. This lack of proper maintenance causes substandard discharges when rainfall exceeds design specifications for sediment control.

The third cause of spills is intentional releases, which occur rarely and are dealt with severely.



A preparation plant at the Shamrock Coal Company visited by Black Water Task Force members in May 2004. Photo courtesy of the Environmental and Public Protection Cabinet.

Some Black Water Task Force members and mine employees leaving Ohio Coal Company's Big Run underground mine in May 2004. Photo courtesy of the Environmental and Public Protection Cabinet.

Section Three: Effects of Black Water Spills

This section evaluates potential human health and ecological effects and effects on habitat that can be a result of a black water spill.

1. Initial Data Evaluation

Significant Findings

- Slurry samples from the Martin County Coal Corporation Slurry Spill were initially compared to background conditions. It was discovered that concentrations of metals in slurry are similar to mean values in soils in Kentucky. Concentrations of metals in slurry, however, are higher than values typically observed in stream sediment in eastern Kentucky.

- When compared to the range of background soils, the range of maximum values observed of metals in slurry were within the range of typical metal values in Kentucky soils.

- Ambient concentrations of metals tested in eastern Kentucky stream sediments are typically higher than values of statewide conditions.

- Slurry samples from the Martin County Coal Corporation Slurry Spill were found to be non-toxic.

- Chronic health effects from black water spills are not anticipated. However, initial effects on animals and plants (biota) due to habitat destruction and smothering are proportionate to the magnitude of the release. Impact to humans, de-

pending on the size of the release, can be the loss of drinking water sources and property damage.

The degree of impact of a black water spill is dependent on the size of the release and the concentration of individual contaminants in the release. Effects range from increases of suspended solids in surface waters to destruction of aquatic habitat and temporary disruption of drinking water supplies. Black water contains complex organic compounds, sulfur, silica, iron oxide, calcium oxide, sodium, and trace metals (ATSDR, 2003a). Flocculants, which are additives used in the coal preparation process to settle suspended fine particulates, may also be present.

Slurry and water samples as a result of the Martin County Coal Corporation Slurry Spill were collected in Martin County as part of the response and cleanup efforts by the Cabinet, the U.S. Environmental Protection Agency (EPA), the U.S. Mine Safety and Health Administration (MSHA), and Martin County Coal Corporation.

Remediation efforts in the affected watersheds and waterways in the vicinity of the Big Branch slurry impoundment show signs of recovery to pre-spill conditions (control sites). These watersheds and waterways, however, are still biologically impaired in comparison to regional reference reach streams (See Figures 1 and 2).[1]

[1] Regional reference reach streams represent background conditions in the ecoregion and are selected based on their reduced impact status. Non-slurried control sites are adjacent sites that were not affected by slurry and represent pre-spill conditions typical of watersheds with similar land use activities and physical setting.

Figure 1. Macroinvertebrate Index Scores for Impacted, Control, and Regional Reference Conditions

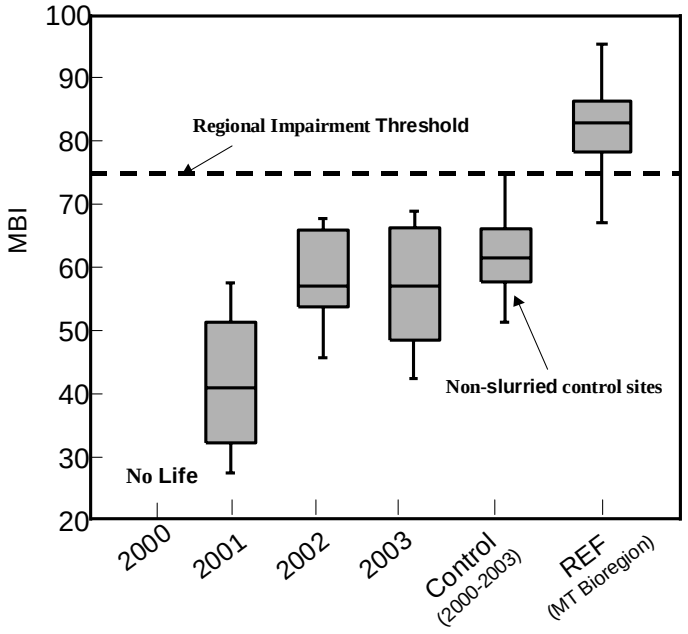
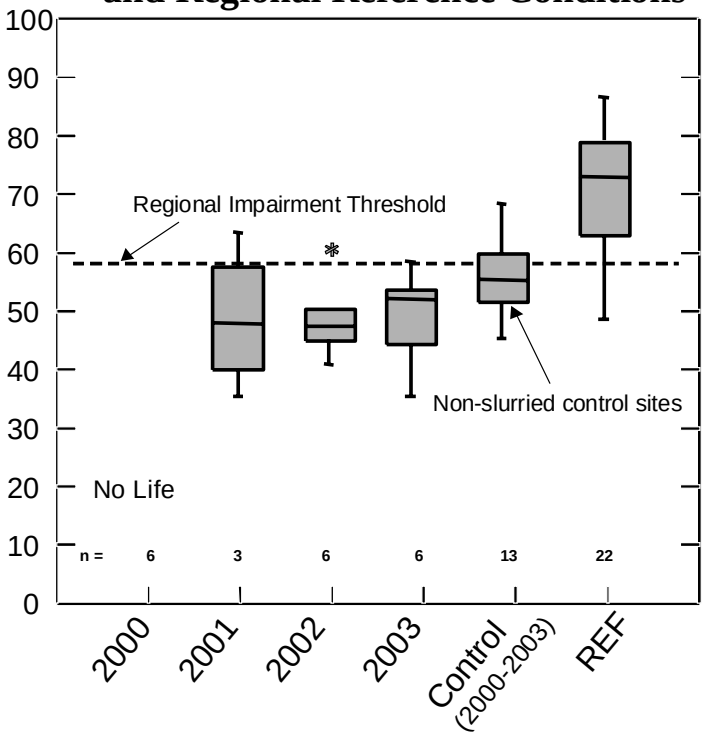


Figure 2. Fish Index Scores for Impacted, Control, and Regional Reference Conditions



Figures 1 and 2 from Pond, Greg. 2004 (unpublished). Water Quality Impacts From Coal Mining Releases.

The Cabinet used the analytical data summarized in the Agency for Toxic Substances and Disease Registry (ATSDR) report on the Martin County Coal Corporation Slurry Spill to conduct a screening assessment of potential effects associated with black water spills.[1] The screening assessment took a conservative approach by using the maximum value for each constituent evaluated.

A screening-level risk assessment was completed to identify contaminants of concern and potential human health and ecological effects associated with the chemicals listed in Tables 1 through 4. These tables summarize the analytical data for metals and organics in slurry and surface water and the respective background concentrations for the metals in soil, sediment and surface water.[2] The tables also contain the human health and ecological screening values that were used in the evaluation of the potential toxic effects described in this report. If the maximum value for a particular metal or organic compound chemical in a particular category was lower than background values or human health and ecological values, then that chemical was eliminated from further consideration.

To identify contaminants of concern in the coal slurry, the maximum values of the metals shown in Table 1 were initially compared to the mean or median background concentrations of metals in soil and sediment in Kentucky. Background concentrations specific to the soils and sediment in eastern Kentucky coalfields were also identified from the statewide dataset of background concentrations.[3] These values represent ambient conditions and are comprised of reference and naturally occurring values, and impacts as a result of anthropogenic activities. Metals in the slurry with maximum values less than

[1] ATSDR conducted a health consultation to evaluate potential impacts of the Martin County Coal Corporation Slurry Spill on public health. Part of that consultation was a summary of the sampling data collected up to the time of theATSDR study and the range of concentrations observed in slurry and surface water. The study's conclusions have been questioned by Eastern Kentucky University; however, the Cabinet used the sampling numbers and not the conclusions of the ATSDR report in conducting its own screening.

[2] Background concentrations are values that represent typical ambient conditions for soil, sediment and water in Kentucky and in regions of the eastern Kentucky coalfields.

[3] Due to other activities in these areas, the contribution of black water spills and coal extraction, preparation and transport processing activities to ambient conditions is unknown. Concentrations in slurry and sediment in eastern Kentucky of several of the metals (e.g., selenium) are higher than statewide sediment values and comparable to concentrations typical of those found in coal (ATSDR, 2003b).

mean or median concentrations found in soils and sediments in Kentucky required no further evaluation. The soil background values that were used are part of a study completed for the Division of Waste Management's Voluntary Cleanup Program (established in 401 KAR 100:030) and represent statewide background concentrations. Stream sediment background concentrations were obtained from the Kentucky Division of Water based on samples collected statewide and in the eastern Kentucky coalfields. The soil and sediment reference values that were exceeded by the maximum value in the slurry samples are identified by shaded cells in Tables 1 through 4.

Median concentrations in Kentucky streams were not provided for five metals (arsenic, cadmium, chromium, lead, and zinc) because these metals were detected in less than 50 percent of samples that were collected. Estimating a median value would result in a nondetected value being the median.

The metals in Table 1 that were identified for further evaluation after comparison to midpoint background soil levels were beryllium, cadmium, mercury, and selenium.[1] In addition to these metals, aluminum, arsenic, barium, chromium, and lead were also identified for further evaluation after comparison to typical sediment values. These nine metals were evaluated for potential human health and ecological effects. When compared to the range of background soils, even the maximum values observed in the slurry were within the range of typical values in soil.

In recent years selenium has gained attention due to the accumulation of selenium in organisms and the adverse effects of selenium on fish and wildlife. It is not a significant concern for human health but is a potential concern for ecological impact. Selenium tends to be present in higher concentrations in soils and wetlands near marine shale deposits. Water bodies, such as wetlands, that have a high potential for evaporation and lakes and ponds that terminate or contain a limited outlet also contribute to the potential for selenium toxicity (USGS, 1999). In the task force's study, concentrations of selenium in slurry and sediment for the eastern Kentucky coalfields are similar to concen-

[1] The maximum value for three metals was less than the 95th percentile of soil values. The maximum value for selenium was less than the maximum statewide selenium value.

Table 1. Screening of Martin County Slurry Samples – Metals (mg/kg) (Shading indicates if slurry concentration exceeded this value.)

Metal	Maximum concentration in Semi-solid Slurry	KY Soil Mean[1]	EKY Coalfields Soil Mean[2]	KDOW Stream Sediment (Median)[3]	KDOW EKY Coalfields Stream Sediment (Median)[4]	Human Health Screening Value[5]	Ecological Sediment Screening Value[6]	Ecological Soil Screening Value[7]
Aluminum	7790	10969	8870	7490	6397	76000	58030[8]	50
Arsenic	8.0	8.9	12.8	2.67	3.12	0.39	7.24	10
Barium	110	111.3	138.9	86.5	97.9	5400	Not Available	165
Beryllium	1.3	0.8	0.6	Not Analyzed	1.05	150	Not Available	1.1
Cadmium	1.43	0.68	1.5	0.3	0.57	37	1	1.6
Chromium	14.3	20.5	24.2	12.9	12.8	30	52.3	0.4
Cobalt	Not Analyzed	11.9	13.2	Not Analyzed	17.4	900	50[9]	20
Copper	35	18.9	19.7	11.3	12.82	3100	18.7	40
Iron	18,043	22,456	28,836	19,700	19,804	23,000	2%[10]	200
Lead	21	30	49	17.9	21.6	400	30.2	50
Manganese	310	1017	510.4	997	1215	1800	460[10]	100
Mercury	0.07	0.06	0.1	0.04	0.06	6.1	0.13	0.1
Selenium	2.56	0.94	0.7	0.25	2.92	390	Not Available	0.81
Zinc	42	55	49	58.8	69.6	23000	124	50

[1] From voluntary cleanup regulation (401 KAR 100:030), represents statewide ambient conditions
[2] Eastern Kentucky Subset of "KY Soil Mean"
[3] Stream Sediment Values Collected Statewide by Kentucky Division of Water
[4] Subset of KDOW Stream Sediment
[5] U.S. EPA Region 9 PRG for residential soil
[6] U.S. EPA Region 4 ecological sediment screening value, unless otherwise noted
[7] U.S. EPA Region 4 ecological soil screening values
[8] Jones, D.S., G.W. Suter, and R.N. Hull. 1997 (probable effects level)
[9] Persaud, D., R. Jaagumagi, and A. Hayton. 1993 (low effects level)
[10] Persaud, et al.1993; NJDEP, 1998; and NYSDEC, 1999

Notes: Chromium assumes all hexavalent chromium, mercury assumes all methylmercury, and aluminum is typically screened against soil pH as well. The pH of 5.5 or below indicates potential of soluble aluminum, the toxic form.

trations measured in coal (ATSDR, 2003b; WVGES, 2002).

Table 3 compares metals in surface water to health-based screening values and ambient concentrations. Surface water background levels were obtained from the Kentucky Division of Water for comparison to surface water samples. The metals in Table 3 were above the median concentrations observed in eastern Kentucky and statewide values for surface water.

Tables 2 and 4 summarize the available data for organic compounds in slurry, sediment and surface water samples compared to human health and ecological screening values. The results of these comparisons are discussed in the following sections.

Table 2. Screening of Martin County Slurry and Sediment Samples – Organics (mg/kg)
(Shading indicates if slurry concentration exceeded this value.)

Chemical	Maximum Concentration in Slurry\Sediment	Human Health Screening Value[1]	Ecological Sediment Screening Value[2]	Ecological Soil Screening Value[3]
2-Methylnaphthalene	2.7	56	330	Not Available
Naphthalene	1.6	56	330	0.1
Phenathrene	0.9	Not Available	330	0.1
Toluene	0.08	520	Not Available	0.05
Xylene	0.08	270	Not Available	0.05
Benzo(a)anthracene	0.08	0.62	330	Not Available
Benzo(b)fluoranthene	0.05	0.62	Not Available	Not Available
Benzo(k)fluoranthene	0.04	6.2	3.6[4]	Not Available
Benzo(a)pyrene	0.07	0.062	330	0.1
Benzo(g,h,i)perylene	0.03	Not Available	0.72[4]	Not Available
Chrysene	0.09	62	330	Not Available
Dibenz(a,h)anthracene	0.02	0.062	330	Not Available
Fluoranthene	0.15	2300	330	0.1
Fluorene	0.07	2700	330	Not Available
Indeno(1,2,3-cd)pyrene	0.02	0.62	0.69[4]	Not Available
Pyrene	0.22	2300	330	0.1
Low molecular weight PAHs			330	
Total PAHs			1684	

[1] U.S. EPA Region 9 PRG for residential soil
[2] U.S. EPA Region 4 ecological sediment screening value
[3] U.S. EPA Region 4 ecological soil screening values
[4] Barrick, 1988
Note: The human health screening value for naphthalene was used as a surrogate for 2-methylnapthalene for human health.

Table 3. Screening of Martin County Surface Water Samples – Metals (mg/L) (Shading indicates if water sample exceeds this value)

Metal	Maximum concentration in Surface Water	KDOW Stream (median) [1]	KDOW EKY (median)[2]	Maximum Contaminant Level (MCL)	Domestic Water Supply Criteria[3]	Human Health Screening Value[4]	Aquatic Life Criteria[5]
Aluminum	381	0.318	0.188	Not Available	Not Available	36	Not Available
Arsenic	0.12	>50%ND	>50%ND	0.05	0.01	0.000045	0.15
Barium	7.49	0.038	0.043	2	1	2.6	Not Available
Beryllium	0.056	Not Available	Not Available	0.004	0.004	0.073	Not Available
Cadmium	0.021	>50%ND	>50%ND	0.005	0.005	0.018	0.00075
Chromium	0.499	>50%ND	>50%ND	0.1	0.1	0.11	0.011
Cobalt	0.056	Not Available	Not Available	Not Available	Not Available	0.73	Not Available
Copper	1.26	0.001	0.001	1.3	1.3	1.5	0.03
Iron	606	0.545	0.504	Not Available	Not Available	11	1
Lead	0.645	>50%ND	>50%ND	0.015	Not Available	Not Available	0.019
Manganese	7.67	0.075	0.077	Not Available	Not Available	0.88	Not Available
Mercury	0.00167	0.00000142	0.00000137	0.002	0.002	0.003	0.00091
Selenium	0.008	Not Available	Not Available	0.05	0.17	0.18	0.005
Zinc	5.25	>50%ND	>50%ND	Not Available	7.4	11	0.388

[1] Stream Water Values Collected Statewide by Kentucky Division of Water
[2] Subset of Kentucky Division of Water Stream Water Values
[3] 401 KAR 5:031 Assumes consumption of water and organism
[4] U.S. EPA Region 9 PRG for tap water
[5] 401 KAR 5:031 Table 1

Notes: The MCL for lead is an action level that is applied at the tap. The mercury human health screening value is for methylmercury. The water quality criteria for cadmium, copper, lead, and zinc were calculated using a hardness of 400 mg/L $CaCO_3$ during a spill event. Hardness in samples analyzed by the Division of Environmental Service following the Martin County Coal Corporation Slurry Spill ranged from 371 to 11000 mg/L $CaCO_3$. Potesta and Associates used 420 mg/L $CaCO_3$ for calculating hardness-dependent water quality criteria.

Table 4. Screening of Martin County Surface Water Samples – Organics (µg/L)
(Shading indicates if water sample exceeds this value.)

PAH	Maximum Concentration	Domestic Water Supply Criteria[1]	Human Health Screening Value[2]
2-methylnaphthalene	1.21	Not Available	see naphthalene
Naphthalene	0.793	Not Available	0.0062
Pyrene	0.113	0.83	0.18
Fluorene	0.105	1.1	0.24
Fluoranthene	0.0792	0.13	1.5
Benzo(a)anthracene	0.629	0.0000038	0.000092
Chrysene	0.0649	0.0000038	0.0092
Benzo(b)fluoranthene	0.0649	0.0000038	0.000092
Acenaphthylene	0.0382	0.67	0.37

[1] 401 KAR 5:031 Assumes consumption of water and organism
[2] U.S. EPA Region9 PRG for tap water
Note: The human health screening value for acenaphthene was used as a surrogate for acenapthylene.

Some Black Water Task Force members and mine employees preparing to enter Central Appalachian Mining's Rob Fork Mine in May 2004. Photo courtesy of the Environmental and Public Protection Cabinet.

2. Effects on Humans and Potential Health Effects

Significant Findings

- Evaluation of data on black water spills indicates minimal effects on human health. The primary effect of a large black water spill is temporary disruption of public drinking water supplies and aesthetic damage to homes and property.

- Monitoring of the finished water supply in the Inez Municipal Water Supply System (Inez, Ky.) did not indicate levels of chemicals above the maximum contaminant levels that were attributable to the Martin County Coal Corporation Slurry Spill.

- Health effects are expected to be no higher than those from typical exposure to soils in Kentucky because of the similarity between the metals in slurry samples and ambient soil and sediment levels. Any accumulation in tissues of aquatic organisms, including fish, due to this spill would likely be no different from uptake from stream sediments.

Technical Summary

Health effects of black water discharges are dependent on the size of the release and the concentration of individual contaminants in the release. Discharges of coal particles were of concern initially due to the numerous metals and semivolatile and volatile organic compounds that are associated with coal. Health effects associated with any additives used in the processing of the coal, such as flocculants, were also of concern initially if present in soil, sediment, or water. The data reflects that due to the similarity between the levels of metals in slurry samples and the levels of metals in ambient soil and sediment samples, long-term health impacts are not expected. Black water spills are

not expected to create distinct adverse human health consequences from the consumption of fish since accumulation in tissue of aquatic organisms due to the Martin County Coal Corporation Slurry Spill was no different from uptake from typical stream sediments.

Human health effects associated with black water were evaluated based on water, sediment, and slurry samples taken following the Martin County Coal Corporation Slurry Spill. To evaluate potential human health impacts, maximum values of the chemicals greater than background levels were compared to U.S. EPA Region 9 Preliminary Remediation Goals (PRGs). PRGs are calculated based on target risk levels. The soil PRGs consider incidental ingestion of soil and inhalation of airborne dust for metals and semivolatiles, and some of the PRGs from U.S. EPA Region 9 also consider dermal uptake, or the uptake of chemicals through the skin, of contaminants. Exposure pathways for each chemical are shown in Table 5.

As displayed in Tables 1 and 2, the maximum slurry concentrations for nine metals and 16 organics were identified as chemicals of concern. These chemicals of concern were compared to the human health-based screening values with the assumption that the slurry from the Martin County Coal Corporation Slurry Spill was deposited on the soil and exposure to humans occurred from incidental contact with the soil. Only arsenic and benzo(a)pyrene were higher than the health-based values for the slurry.[1] However, due to using maximum values in the screening, benzo(a)pyrene can be ruled out since its maximum value is only slightly above the screening value, and the statistical upper-bound estimate of average is typically used as the exposure concentration. The arsenic concentration was higher than the PRG for soil, but arsenic concentrations in the slurry samples are equivalent to Kentucky soil background arsenic concentrations, so health effects are not expected to be different than those from exposure to typical soils in Kentucky.

Maximum concentrations in surface water were compared to human health screening values from U.S. EPA Region 9. The Human Health Screening Value column

[1] Regardless of comparison to background levels in soil and sediment, arsenic and benzopyrene are still the only chemicals that are above human health screening values.

Table 5. Pathways used when calculating U.S. EPA Region 9 Preliminary Remediation Goals.

Chemical	Residential Soil PRG	Residential Tap Water PRG
Metals		
Aluminum	Soil ingestion, inhalation of airborne dust	Ingestion
Arsenic	Soil ingestion, inhalation of airborne dust, dermal exposure	Ingestion
Barium	Soil ingestion, inhalation of airborne dust	Ingestion
Beryllium	Soil ingestion, inhalation of airborne dust	Ingestion
Cadmium	Soil ingestion, inhalation of airborne dust, dermal exposure	Ingestion
Chromium	Soil ingestion, inhalation of airborne dust	Ingestion
Cobalt	Soil ingestion, inhalation of airborne dust	Ingestion
Copper	Soil ingestion, inhalation of airborne dust	Ingestion
Iron	Soil ingestion, inhalation of airborne dust	Ingestion
Lead	IEUBK Model	Not available
Manganese	Soil ingestion, inhalation of airborne dust	Ingestion
Mercury	Soil ingestion, inhalation of airborne dust	Ingestion
Selenium	Soil ingestion, inhalation of airborne dust	Ingestion
Zinc	Soil ingestion, inhalation of airborne dust	Ingestion

Chemical	Residential Soil PRG	Residential Tap Water PRG
Organics		
2-Methylnaphthalene	Soil ingestion, inhalation of volatiles and airborne dust	Ingestion, inhalation while showering
Naphthalene	Soil ingestion, inhalation of volatiles and airborne dust	Ingestion, inhalation while showering
Toluene	Soil ingestion, inhalation of volatiles and airborne dust	
Xylene	Soil ingestion, inhalation of volatiles and airborne dust, dermal exposure	
Benzo(a)anthracene	Soil ingestion, inhalation of airborne dust, dermal exposure	Ingestion
Benzo(b)fluoranthene	Soil ingestion, inhalation of airborne dust, dermal exposure	Ingestion
Benzo(k)fluoranthene	Soil ingestion, inhalation of airborne dust, dermal exposure	
Benzo(a)pyrene	Soil ingestion, inhalation of airborne dust, dermal exposure	
Benzo(g,h,i)perylene	Not Available	
Chrysene	Soil ingestion, inhalation of airborne dust, dermal exposure	Ingestion
Dibenz(a,h)anthracene	Soil ingestion, inhalation of airborne dust, dermal exposure	
Fluoranthene	Soil ingestion, inhalation of airborne dust, dermal exposure	Ingestion
Fluorene	Soil ingestion, inhalation of volatiles and airborne dust	Ingestion, inhalation while showering
Indeno(1,2,3-cd)pyrene	Soil ingestion, inhalation of airborne dust, dermal exposure	
Pyrene	Soil ingestion, inhalation of volatiles and airborne dust	Ingestion, inhalation while showering
Acenaphthylene		Ingestion, inhalation while showering

in Table 3 and Table 4 evaluate ingestion of water. The surface water samples were also compared to other basic criteria such as domestic water supply (DWS) criteria from 401 KAR 5:031 and Maximum Contaminant Levels (MCLs). MCLs are health-based values for the treated drinking water supply that considers both the protection of human health and technologies available for treatment. DWS criteria consider human consumption of water and ingestion of fish from streams.

The maximum values for surface water samples were compared to MCLs, DWS, and U.S. EPA Region 9 Preliminary Remediation Goals. This conservative approach of comparing maximum detected values to health-based values eliminated cobalt, copper, manganese, mercury, selenium, zinc, pyrene, fluorene, fluoranthene, and acenaphthylene from further evaluation. The remaining chemicals were evaluated qualitatively.

Two factors led to the conclusion that there is not a significant health concern with the surface water as a result of the Martin County Coal Corporation Slurry Spill. The first factor is that the concentrations of the chemicals tested in the water decreased rapidly after the initial impact of the spill. Samples taken by the Division of Water in Coldwater Fork for chromium and copper were observed to drop to negligible levels within two weeks following the Martin County Coal Corporation Slurry Spill and organics are expected to exhibit the same trend. Maximum concentrations of the chemicals were used for this screening analysis. Statistical estimates of the long-term exposure concentration are likely lower than the maximum values that were detected. Periodic, temporary spikes in concentration of the chemicals assessed correlated with rainfall events.

The second factor is that the compounds observed in the samples have low water solubility. Low water solubility means that the compounds were bound to the particulates in the water so that filtration of the water decreased the concentrations of the compounds and metals in the water. This was observed in the surface water samples analyzed by the Division of Environmental Services (DES) following the spill. These samples had very

high concentrations of total metals, but an analysis of dissolved metals in the same samples revealed much lower concentrations. This supports the hypothesis that the majority of the metals were tied up with the suspended solids and sediments. Much like metals, polycyclic aromatic hydrocarbons (PAHs) have low water solubility and were expected to be bound to the suspended solids. PAHs should be removed as a result of water treatment.

Even though direct exposure to unfiltered water is a possibility in some circumstances, particularly in recreation scenarios and for ecological receptors, the higher concentrations of chemicals were tied to the suspended solids and the observed concentrations in the water samples were much lower in filtered than in unfiltered samples. It is assumed that finished water for human consumption would undergo filtration and treatment prior to exposure for residents on water systems. As reported by the Kentucky Environmental and Public Protection Cabinet Drinking Water Branch, public water supplies for the Martin County Water District in Inez, KY have not had significant, long-term problems related to the Martin County Coal Corporation Slurry Spill.

Chemical additives for flocculation of fine particulates are normally used in the process of managing the coal slurry and were not present in samples collected for the evaluation. Three months after the Martin County Coal Corporation Slurry Spill, Triad Engineering, Inc. commissioned the Charleston Laboratory of CT&E Environmental Services, Inc. to test the affected areas of Coldwater Fork of Rockcastle Creek, Wolf Creek, which flows into the Tug River, and the slurry for acrylamide (the flocculant used by Martin County Coal Corporation). Acrylamide is water-soluble and biodegrades. It persists in the environment for days to months depending on the presence of biological organisms, the temperature and aerobic conditions. Acrylamide is often used in drinking water systems as a flocculate. Acrylamide was not detected in the analysis.

The Agency for Toxic Substances and Disease Registry (ATSDR) published a health consultation in response to a citizen group's request. Area citizens were concerned about skin rashes, nausea, and headaches they alleged were related to contaminated

public water. The consultation included an evaluation of slurry, sediment, groundwater, and surface water data. The ATSDR report concluded that slurry concentrations of metals from the Martin County Coal Corporation Slurry Spill were similar to background levels of soil and that organic constituents did not exceed comparison values (ATSDR, 2003a). Although short-term exposures to slurry materials in yards were likely to have occurred, the pathways of exposure should no longer exist after the removal and covering of residues as part of the normal remediation process.

The report concluded that the potential for skin irritation, rashes, and other short-term events could occur following the spill but are not expected to pose a long-term hazard since remediation of impacted areas occurred within one year following the Martin County spill. The report also concluded that resuspension of sediments containing residual levels of slurry particles could result in episodic events, but treatment of public drinking water supplies should limit exposure to remaining sediment particles.

Seventy samples were taken from 38 private water wells in the area to evaluate groundwater. Analytical results were similar to regional ground water quality and historical data. Therefore, private wells were not considered to be impacted by the slurry spill (ATSDR, 2003a).

3. Ecological Effects

Significant Findings

- The primary effect of black water spills on the environment include the smothering of organisms through interference with the gill surface and habitat destruction.

- Slurry, sediment, and surface water samples were higher than first-tier ecological screening values used for initial site screening in ecological risk assessment.[1]

[1] In ecological risk assessment, exceedances of the first tier is a trigger for further evaluation. The next step involves developing a conceptual site model and comparing the calculated exposure to Toxicity Reference Values (TRVs), and if necessary, that step would be followed by site-specific toxicity testing and in-situ monitoring.

Metals in slurry were slightly higher for arsenic, cadmium, and copper using sediment screening values where soil screening values identified six metals (aluminum, beryllium, chromium, iron, manganese, and selenium) that required further evaluation. Six polycyclic aromatic hydrocarbons – naphtha lene, phenanthrene, toluene, xylene, fluoranthene, and pyrene – were slightly higher than ecological soil screening values and none were above sediment screening values.

- Water samples collected from Wolfe Creek following the Martin County Coal Corporation Slurry Spill (sample sites MC-25 and MC-27) showed no statistically significant increase in mortality to either the minnow or the daphnid in 48-hour static acute tests. The lack of acute toxicity of the slurry and slurry/ water mixtures is probably because the pollutants are bound to the coal and clay particles and are not bioavailable, meaning that the pollutants are not available for uptake by organisms.

- Longer-term chronic toxicity tests on *Hyallela azteca*, *Daphnia magna*, and *Pimephales promelas* organisms did show some effects on test organisms. However, these are likely the result of high-suspended solids concentrations and not toxic effects in Coldwater Fork and Wolf Creek.

Technical Summary

No other black water spills to date in Kentucky have approached the magnitude or caused the catastrophic loss of aquatic life that resulted from the Martin County Coal Corporation Slurry Spill. However, at least four reported black water spills from 2002 to 2004 resulted in fish kills (Kentucky Department of Fish and Wildlife Resources, 2004) for the same basic reasons: smothering of organisms through interference with the gill surface and habitat destruction, both of which are caused by settlable solids, or solids that

settle out of suspension (see Table 6).

Macroinvertebrates and fish are asphyxiated as their gills become clogged. Also, sedentary, attached, and some mobile organisms are unable to avoid the spill and are buried. Benthic algae may be totally eliminated by smothering and reduced light penetration. Fish will seek to avoid the spill by moving downstream and into refuge tributary streams. Many macroinvertebrates will also attempt to avoid the spill by releasing into the current as "drift." Where solids are deposited, habitat smothering causes short- and long-term effects that persist until the solids are washed downstream in the next significant rain event.

Smaller and diluted spills may result in sub-lethal effects to the aquatic environment, but lesser in degree than those described in the previous paragraph. Fish will exhibit avoidance behavior of the affected reaches and may have reduced ability to feed because of visual impairment. They may also experience reproductive loss because of degraded habitat for spawning and direct effects to eggs, embryo and larval life forms. Macroinvertebrates move to less affected areas as drift.

Concentrations of several constituents, including cadmium, chromium, copper, iron, lead, mercury, and zinc in stream samples following the Martin County Coal Corporation Slurry Spill greatly exceeded water quality criteria for warm water aquatic life as found in Kentucky Water Quality Standards regulations 401 KAR 5:031 (see Table 3). However, studies of the toxic effects of the Martin County Coal Corporation Slurry Spill indicated no increase in mortality based upon acute toxicity tests performed on slurry porewater or effluent using the daphnid *Ceriodaphnia dubia* or the minnow *Pimephales promelas*.[1] Likewise, discharge from Wolf Creek following the Martin County Coal Corporation Slurry Spill (MC-25 and MC-27) showed no statistically significant mortality to either the minnow or the daphnid in 48-hour static acute tests. The lack of acute toxicity observed in the testing of the slurry and slurry/water mixtures may be due to the likelihood that the pollutants are bound to the coal particles and are not bioavailable.

[1] Porewater is the water inside the microscopic cracks and crevices in and between slurry particles.

Longer-term chronic tests did show some effects on test organisms; however, these are likely the result of high suspended solids concentrations and not the result of chemical toxicity.

Results from location MC-52 (Coldwater Fork) for the amphipod, *Hyallela azteca*, showed statistically significant mortality in a 10-day static, renewal toxicity test of the slurry itself. A 7-day static, renewal test using the daphnid *Daphnia magna* indicated the slurry was not significantly lethal to the test animal, but did cause reproductive impairment.[1] The third test organism, the midge *Chironomus tentans*, showed no statistically significant response. However, unfiltered water from MC 44/43 used in a 7-day, flow through, chronic test using fat head minnows, *Pimephales promelas* resulted in a no observable-effect concentration (NOEC) of < 6.25 %, or a chronic toxicity unit (TUc) value of more than 16.[2] In Wolf Creek at site MC-27, a 48-hour static acute test for sediment porewater resulted in significant mortality to *Ceriodaphnia dubia* (LC50=84.31%; TUa=1.19). *Pimephales promelas* showed no significant mortality to porewater from this location.

Results of sampling by the Division of Water in the eastern region of Kentucky show increased embeddedness of the substrate[3], total dissolved solids, and overall reduced habitat quality in streams with mining and related activities in the watershed as compared to the reference condition (Figures 3 and 4).[4] The health of the macroinvertebrate community is compromised as habitat is degraded (Figure 5).

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[1] *Daphnia magna* was impaired by reduced brood size and reproduction when compared to control populations.

[2] This means that the sample from test of unfiltered water, would have to be diluted by more than 16 times to reach no effect on the organism.

[3] Substrate embeddedness refers the amount of fine sediment surrounding or covering bottom surfaces which are used by biological organisms for food, shelter and reproduction and is a measure of stream habitat quality.

[4] Mining and related activities includes surface mining activities with mountaintop removal and associated preparation of the land (removal of timber and soil). Reference conditions represent sites that did not have mining or residential impacts, but have a history or agriculture, logging or limited residential use.

Table 6. Biological effects of suspended sediment

Benthic Algae
• Reduction of water transparency, substrate smothering, scouring (Graham 1990) • Overall reduction in algal biomass found in many studies • Reduction of food value to macro invertebrates (Waters 1995)
Macroinvertebrates (after Waters 1995)
• Catastrophic drift (avoidance) • Habitat smothering, filling of interstitial spaces • Clogging of feeding and respiratory systems • Smothering of some pupal stages that cannot drift • Physical abrasion • Overall reduction in invertebrate densities
Fish

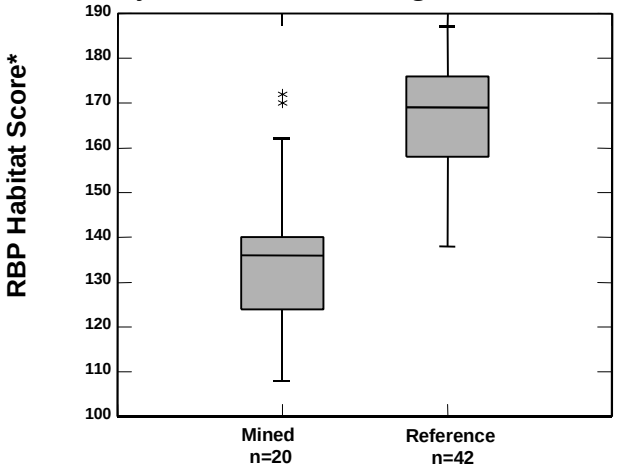
• Lethal Effects (direct mortality)
  • Largely as a result of clogged gills
  • 100,000-200,000 mg/L TSS lethal (Wallen 1951; McLeay 1984)
  • 500-6,000 mg/L TSS for sensitive species including trout (McLeay 1984)
  • "Rough" fish able to withstand 250,000 mg/L TSS (Waters 1995)

• Sub-Lethal Effects (indirect mortality and community alteration)
  • Avoidance (behavioral)
  • Reduced feeding and growth (visual impairment and disorientation)
  • Respiratory impairment (thickening of gill epithelium)
  • Reproductive failure (spawning habitats, egg and embryo development)

Note: Virtually impossible to distinguish effects of the individual heavy metals, pesticides, or other organic compounds when TSS is high

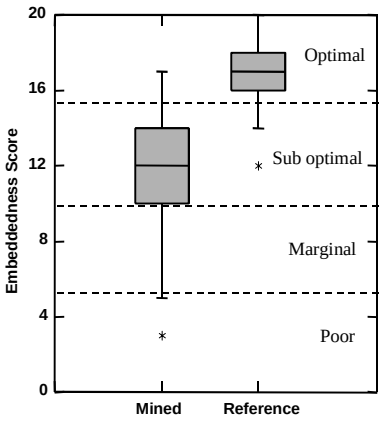
A section of the 2000 Martin County Coal Corporation Slurry Spill. Photo courtesy of the Environmental and Public Protection Cabinet.

Figure 3. Habitat Degradation in Headwater Streams
Affected by Surface Coal Mining in Eastern Kentucky

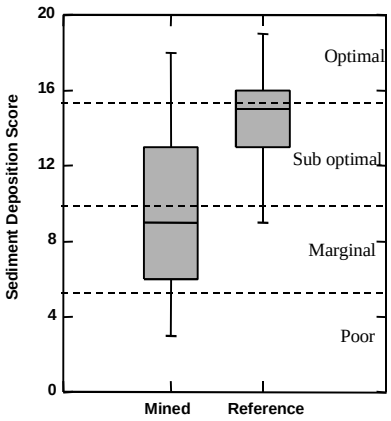


*The RBP habitat assessment is based on 10 metrics (epifaunal substrate, embeddedness, velocity/depth regime, sediment deposition, channel alteration, frequency of riffles, bank stability, bank vegetation, and riparian zone width). Metrics are scored on a 0-20 scale and summed to yield a 200 point index score.

Figure 4. Sedimentation Impacts in Headwater Streams
Affected by Surface Coal Mining in Eastern Kentucky



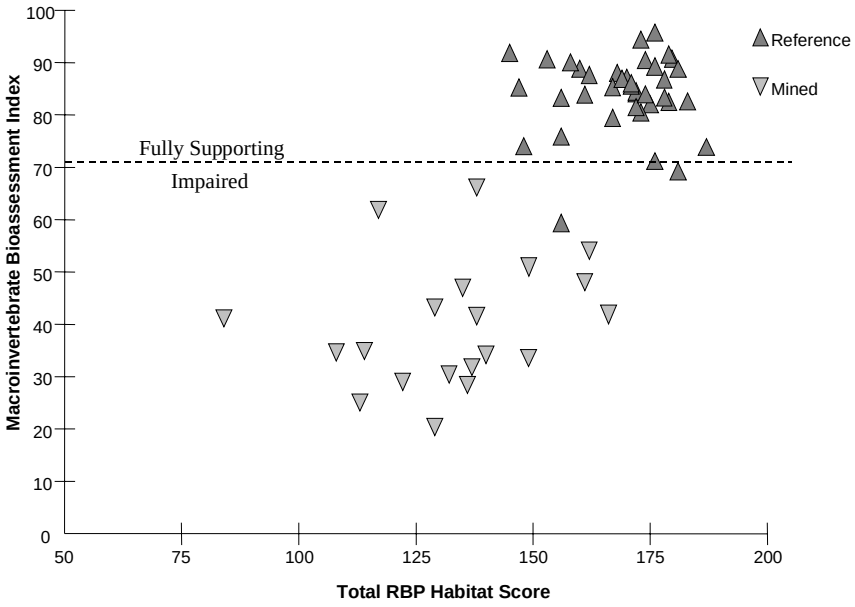
Based on measurements of the fine sediment that surrounds cobble and boulder substrates in riffle habitats. Measured as a percent and expressed as a score (0-20).



Based on measurements of fine and coarse sediment that is deposited in pool areas. Measured as percent cover and expressed as a score (0-20).

Figures 3 and 4 from Pond, Greg. 2004 (unpublished). Water Quality Impacts From Coal Mining Releases.

Figure 5. Macroinvertebrate Bioassessment Index Versus RBP Habitat Scores
Among Mined and Reference Sites in Headwater Streams in Eastern Kentucky



The screening ecological risk assessment shown in Tables 1 through 3 compares the maximum concentration value for each chemical of concern to a screening level for ecological effects. The values in Tables 1 and 2 that were obtained from U.S. EPA Region 4 are compiled from the scientific literature and are intended to be the first step in ecological risk assessment. The maximum values for the metals in Table 1 are above the sediment screening value for arsenic, cadmium, and copper, with arsenic and cadmium only slightly higher than the screening value. The comparison was limited in scope because only one-half of the metals have sediment screening values, so three of the metals could not be evaluated.[1] Aluminum, beryllium, chromium, iron, manganese, and selenium were above the soil screening values. The organic chemicals in Table 2 were also compared to ecological screening values. No constituents were higher than their respective sediment screening values, but the values for naphthalene, phenanthrene toluene, xylene, fluoranthene, and pyrene were higher than the soil screening values. Ecological concerns with the Martin County Coal Corporation Slurry Spill continue to be addressed in the remediation and restoration efforts of the project.

Figure 5 from Pond, Greg. 2004 (unpublished). Water Quality Impacts From Coal Mining Releases.

[1] The metals that were not evaluated were barium, beryllium, and selenium.

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Section Four: Regulatory Authority, Permitting and Enforcement

All surface coal mining operations in Kentucky are regulated under the federal Surface Mining Control and Reclamation Act (SMCRA) of 1977. The intent of SMCRA is to protect the public and environment from adverse impacts of surface coal mining activities. In 1982, Kentucky received authority from the federal Office of Surface Mining (OSM) to administer the provisions of SMCRA with OSM, maintaining program oversight responsibilities. Two agencies within the Department for Natural Resources – the Division of Mine Permits and the Division of Mine Reclamation and Enforcement – are charged with regulating surface coal mining operations in Kentucky under SMCRA.

All coal mining companies are required to obtain a Surface Coal Mining Permit from the Division of Mine Permits prior to beginning operation. All applicants must clearly demonstrate in permit applications how they will comply with the surface mining regulations before the permit is issued. If a proposed coal mining operation cannot demonstrate compliance, a permit cannot be issued.

The surface mining regulations require an applicant to demonstrate in the permit application how the mining operation will be designed and conducted in a manner that ensures that all surface water discharges from the site will meet state and federal water quality standards at all times. Each surface mining application contains an in-stream surface water monitoring plan that must be implemented to ensure that all surface water runoff from the mining operation complies with water quality standards. Each surface water sampling location must be representative of the watersheds receiving discharges from the mining operation. Samples must be submitted quarterly from each monitoring point to the Division of Mine Reclamation and Enforcement. Surface water sampling continues on a quarterly basis throughout the life of the mine until final reclamation is approved. Each sample location is monitored for the following parameters: (1) flow rate, (2) total dissolved solids, (3) total suspended solids, (4) pH, (5) total iron, (6) total manganese, (7) acidity, (8) alkalinity and (9) sulfate.

The regulations also require that all surface runoff from areas disturbed by mining pass through sedimentation ponds prior to being discharged to a receiving stream. Each sediment pond must be designed and maintained to ensure that it will treat the surface water runoff from the mine site sufficient to meet water quality standards. Surface water control measures in addition to sediment ponds may be required to ensure that the discharges from the mine site meet water quality standards.

All point source discharges from the mining activity must be permitted under a Kentucky Pollutant Discharge Elimination System Permit (KPDES permit) issued by the Kentucky Division of Water. The KPDES permit contains the water quality standards and monitoring requirements that must be met by each coal mining operation. A coal mining operation cannot begin until both the Surface Coal Mining Permit and the KPDES permit are issued, and monitoring must continue until final reclamation is approved. The KPDES permit requires the coal company to sample each point source discharge from the mining operation, such as a sediment pond, and to submit the sample results to the regulatory agency on a quarterly basis. KPDES permit sample results are recorded on a Discharge Monitoring Report (DMRs).

Upon issuance of the surface mining permit, the Division of Mine Reclamation and Enforcement assumes responsibility for enforcing the terms of the permit throughout the life of the mining operation until final reclamation. This Division is also responsible for enforcing the terms of the Kentucky Pollutant Discharge Elimination System permit issued by the Division of Water, in accordance with a Memorandum of Understanding between the two agencies.

During the Black Water Task Force's review of the enforcement procedures, it was discovered that the Division of Mine Reclamation and Enforcement was not following the same enforcement procedure as the Division of Water regarding Discharge Monitoring Reports (DMRs) that indicated that one or more water quality standards had been exceeded during the reporting period.

Upon receipt of a DMR indicating a water quality standard had been exceeded, the Division of Mine Reclamation and Enforcement would dispatch an inspector to the permit site to evaluate the source of the water quality problem and take appropriate enforcement action if a violation is found. The Division of Mine Reclamation had not been taking enforcement action based solely on the information contained within the DMR. The Division of Water has the discretion to take enforcement action based on the information contained on the DMR without an independent follow-up inspection. The Task Force recommended that the Division of Mine Reclamation and Enforcement change its enforcement procedure to parallel that of the Division of Water. Both agencies are now working together to develop a procedure that will implement the Task Force's recommendation.

The Division of Mine Reclamation and Enforcement has 87 mine inspectors located in Kentucky's coalfields. They routinely inspect all surface coal mining operations and issue notices of violation if the mining operation is not in compliance with its surface mining or Kentucky Pollutant Discharge Elimination System permits. In 2003, the Division of Mine Reclamation and Enforcement conducted 7,858 complete inspections, which included determining if each permit was in compliance with water quality standards. In that same year it conducted 14,580 partial inspections, a portion of which included inspection of water quality standards. In 2004 there were 10,179 complete inspections and 15,241 partial inspections.

Black water discharges from mining operations are detected through routine inspections of the mine site, citizen complaints and self-reporting by the mining companies. It is imperative that the regulatory authorities respond to a report of a black water spill as quickly as possible. Once the black water discharge ceases the plume will move down stream and become diluted, making it difficult to impossible to determine the source. The Black Water Task Force carefully reviewed all of the enforcement mechanisms currently employed by the Division of Mine Reclamation and Enforcement and Division of Water used to detect black water spills. Upon the recommendation of the

Black Water Task Force, an internal procedure was developed to allow the agencies to coordinate the response to a report of a black water spill. The Division of Mine Reclamation and Enforcement and the Division of Water are the two agencies with primary responsibility to respond to reports of black water spills. Both agencies have now developed a joint protocol for coordinating their response to black water spills and taking appropriate enforcement action. This has improved the ability of both agencies to respond efficiently and effectively and to identify the source of the black water spill. In those instances where a black water spill has resulted in a fish kill, the internal protocol requires the agencies to notify the Kentucky Department of Fish and Wildlife Resources. The Kentucky Department of Fish and Wildlife Resources will take independent enforcement action under its jurisdiction to address the fish kill.

If a black water spill is traced back to a mine site, both the Division of Water and the Division of Mine Reclamation and Enforcement conduct an investigation. The Division of Water concentrates its investigation from the point of the black water discharge down stream. The Division of Mine Reclamation and Enforcement concentrates its investigation from the point of the black water discharge back onto the permit area to determine the cause of the spill. Once the cause is determined, the Division of Mine Reclamation and Enforcement issues a notice of violation (NOV) to the coal company.

The NOV includes the regulatory standards violated, the circumstances surrounding the violation(s) and remedial measures the coal company must follow to prevent future black water spills. Many times the coal company can complete the remedial measures before the mining inspector leaves the site. If a longer period of time is required to implement more extensive remedial measures, the NOV stipulates a deadline for completion. The mining inspector will return to the mine site to ensure that the remedial measures have been completed by the stipulated deadline. Once the remedial measures are implemented to the regulatory standards, the NOV is abated. If a coal company fails to implement the remedial measures by the stipulated deadline, the mining inspector can grant an extension of time for good cause or can issue a failure-to-abate

cessation order. A failure-to-abate cessation order can result in the mining company being ordered to cease all mining activities until the outstanding remedial measures are completed, a fine of $750 per day for each day the violation is outstanding, and a bar to receiving future mining permits until the outstanding violation is resolved.

Once the notice of violation and/or cessation orders have been resolved, a penalty assessment is calculated to determine the amount of the fine. The coal company is notified of the penalty along with a request for payment. The violation is then added to the violation history for that mine permit.

The entrance to the thin seam Blue Gem coal mine. Photo courtesy of the Environmental and Public Protection Cabinet.

Section Five: Best Management Practices

The best management practices (BMPs) and other recommendations in this report are practical, preventative measures with relatively low cost and potential for high effectiveness for use by the coal industry to minimize, reduce or eliminate the occurrence of black water spills. It is the recommendation of the task force to require the use of these BMPs in all areas of coal production. By taking this action, the task force hopes to minimize the number and severity of spills in an effective reasonable manner without the need for more regulations and laws.

The Clean Water Act (CWA) requires the development of BMP plans for permit holders, including coal mining operations. These operations must develop, implement and make available their BMP plans. For coal enforcement of the Kentucky Pollutant Discharge Elimination System (KPDES), the BMP requirement has been delegated to the Division of Mine Reclamation and Enforcement (DMRE) through a Memorandum of Understanding between DMRE and the Kentucky Division of Water. BMP plans are required to be maintained on site and available to DMRE inspectors.

The Black Water Task Force BMPs have been peer-reviewed by industry, public representatives and regulators. Coal companies operating coal preparation plants should be required to include these BMPs or comparable practices, as applicable, in their BMP plans. Common sense and attention to detail are essential in protecting against environmental damage.

Division of Mine Reclamation and Enforcement (DMRE) should review a facility's compliance with BMP plans as a part of its normal and routine inspection process. The Black Water Task Force BMPs are intended for use by existing and new facilities, and it is recommended that these BMPs be required to be incorporated, as applicable, into plans within six months after publication of this report. Where a black water spill results, DMRE should consider the compliance with BMP plan requirements in determining the good faith and lack of negligence of the operator and permittee.

Pipelines

High pressure pipelines used to transport slurry from the thickener underflow pumps to the slurry impoundment shall employ the following design and maintenance criteria:

a. All connections shall be welded, fused or employ positive mechanical couplings, but with no friction couplers. Existing underground slurry lines with friction couplers are not required to be replaced, but in the event of the replacement of an existing underground line or portion thereof, the friction couplers will be replaced to meet this standard.

b. Pipe design shall have a 2:1 factor of safety for pressure capacity. Manufacturers' published burst pressure shall be two times the predicted pressure for any given pipe segment. Many pipes are designed with this safety feature/ ratio in place. However, it is prudent to check with your manufacturer's specifications.

c. Pipe welders used on steel pipe and fusers used on high-density polyethylene (hdpe) pipe shall be experienced and capable.

d. Once per month, the entire pipe line or pipe line route where the pipe is buried shall be visually inspected for leaks, ground movement, pipe gouges or other distress.

e. In order to detect pipe line breaks or leaks. (1) All thickener underflow pumps shall be monitored for amperage in the plant control room by a pump amperage monitor. If amperage deviates $\pm$ 20% of normal, the operator shall be notified by an audible alarm. If the alarm is not overridden by the operator within 15 minutes, the pumps will be shut down automatically. (2) Or, pipe discharge shall be monitored at the discharge end. A flow transducer shall be installed which reports to the control room. If the under flow pumps are operating, the transducer must detect slurry flow. If there is no flow, the operator shall be notified by an audible alarm. If the alarm is not overridden

by the operator within 15 minutes, the pumps will be shut down automatically.

f. Buried pipe lines shall be clearly marked on the surface with warning signs. Equipment operators should be advised concerning buried lines before excavating near buried lines.

g. Pipe lines shall be inspected for wear annually using ultrasonic methods. Operators shall keep records of the annual ultrasonic tests and made available to DMRE inspectors. When the wall thickness reaches a manufacturer's replacement standard, pipe should be rotated or replaced.

h. Operators may consider installing larger diameter fittings at directional changes in order to reduce velocities and wear on pipes and high stress points, such as elbows.

Spill Reporting

Each location at or near a preparation plant with a telephone shall have permanently posted spill reporting procedures and the names and phone numbers of individuals or organizations to be notified in the event of a spill. Additionally, all preparation plant management shall be issued a laminated wallet card with the names and phone numbers of individuals or organizations to be notified in the event of a spill.

Training

The facility BMP and spill reporting procedures shall be reviewed periodically in the weekly safety meetings held by the companies.

Thickener Evacuation Facility

Each preparation plant shall have a pond or alternative method to contain the slurry in order to prevent an unpermitted discharge to the environment when emptying the thickener or during other required maintenance. Onsite inspections of the designated pond or alternative containment shall be conducted daily during the duration of the maintenance or use by company personnel.

Sediment Ponds

The maintenance of sediment ponds shall be supervised by company management to prevent spills or damage to decant systems. Clean out operations should not be conducted during significant rainfall events.

Run-Off Control

The following is a list of BMPs and recommendations for controlling run-off:

- Keep sumps cleaned out.
- Revegetate disturbed areas quickly, such as the face of slurry impoundments and refuse piles.
- Protect slopes with vegetation. Use local materials and native plant species when possible.
- Keep exposed areas small, and leave buffer strips between mine sites and streams.
- Maintain refuse haul roads.
- Maintain a durable surface on all areas used by vehicular traffic.
- Use a non-toxic dust control additive to help reduce dust and sediment load on haul roads.

Impoundments

Through careful analysis, mine operators shall, on their coal waste disposal permits, clearly identify the type and location of underground workings. Alternatives to traditional coal waste disposal methods should be considered before or at the time of permitting. Underground injection of coal slurry and dry coal processing technology are two potential alternatives.

In locating or expanding a coal waste impoundment, the possibility of impoundment pool failure into underground mine works should be thoroughly assessed. Available mine maps should be consulted and the location and extent of former works and thickness and competency of the outcrop barrier relative to the impoundment structure and

pool should be validated through verification drilling or other geotechnical assessment.

Impoundments should not be approved over or within the angle of draw of underground mine works unless the former works are below drainage, or through on-site drilling or other appropriate geotechnical assessment, it is demonstrated that sufficient, competent materials exist to prevent pool failure into such works. Where practicable, impoundments should be limited to locations where the impoundment is classified at the lowest hazard classification for embankment breach.

Coal waste impoundments should be bonded for the full cost of closure and reclamation. Liability insurance required under law should include bonding or any other acceptable financial assurance to cover the amount of the deductible. (Refer to 405 KAR Chapter 10).

Emergency action plans

Emergency action plans (EAPs) and/or emergency warning plans should be required for all high and moderate risk impoundments. Worst-case failure scenario and alternative management approaches should be considered as these plans are created. The Federal Guidelines for Dam Safety from the Federal Emergency Management Association's (FEMA) National Dam Safety Program explain the process for developing EAPs at: http://www.fema.gov/fima/damsafe/eap_toc.shtm. The Kentucky Coal Association (KCA) has developed a model plan for consideration by its members in response to FEMA recommendations. The KCA's emergency warning plan can be found in Appendix A.

Conclusion

The Black Water Task Force worked diligently to find consensus for this list of Best Management Practices (BMPs) and recommendations. Its overarching goal is to minimize the number and severity of black water spills. Implementation of these measures – while creating some additional capital or other direct costs – will lower risks of releases and reduce long-term costs by avoiding or minimizing the cost for remediation of natural resource damage and compensation for property damage and personal injury from releases and spills. To this end, the implementation of these BMPs is an opportunity for the coal industry to truly make a difference.

A slurry pond at the Shamrock Coal Company site visited by members of the Black Water Task Force in May 2004. Photo courtesy of the Environmental and Public Protection Cabinet.

Appendix A

Emergency Action Plans

Kentucky Coal Association
Emergency Warning Plan

An emergency warning plan shall designate the person in charge of contacting county emergency officials and residents to ensure all persons are notified and evacuated from affected areas in the event of a pending impoundment failure.

The emergency warning plan shall contain procedures for notifying the following:

- Key company personnel
- Employees designated to assist in notification and evacuation of residents
- County Sheriff's Department
- State and federal agency officials with oversight over the impoundment
- Division of Water Environmental Response Team
- County Disaster and Emergency Services
- Local Media

The local media will be instructed to repeatedly broadcast an announcement similar to the following:

This is an emergency. The _____ impoundment structure located in _____ may fail at any time. Please if you live along _____(name of stream)_____ near _____(location of impoundment)____ either move to higher ground immediately or leave the area.

In addition to the media announcement, the local law enforcement and emergency people in conjunction with designated personnel will notify downstream residents along the stream.

A responsible person shall monitor the impoundment from a safe location and stay in contact with emergency personnel by radio or phone during an emergency situation.

Suggested Format from the FEMA64r
Federal Guidelines for Dam Safety
Emergency Action Planning for Dam Owners

Basic Considerations for Preparing Emergency Action Plans (EAPS)

A suggested format is provided in these guidelines to ensure all six basic elements are included in an Emergency Action Plan (EAP), to provide uniformity, and to encourage thorough and consistent emergency action planning for levels of preparedness that may save lives and reduce property damage in areas affected by dam operation or failure. It is important that dam owner and regulatory requirements be satisfied when selecting a format for an EAP.

Although it is not necessary to follow exactly the format outlined below, it is necessary that all EAPs within a given jurisdiction be similar and consistent to eliminate confusion when activating any EAP. To the extent possible, an EAP should be organized in the format that is most useful for those involved in the plan. The EAP must be user friendly so that it will actually be used during EAP exercises and actual emergency events. Regardless of the format used, development of an EAP should consider the elements described on the following pages to ensure all aspects of emergency action planning are covered.

It is helpful to place the EAP in a loose-leaf binder so that outdated pages (or the entire EAP) can be easily removed and replaced with updated information, and to ensure a complete, current, and workable plan. It is also beneficial to place the date of the EAP or current revisions on each page.

The suggested format for an EAP appears below:

Title Page/Cover Sheet
Table of Contents

I. Notification Flowchart
II. Statement of Purpose
III. Project Description
IV. Emergency Detection, Evaluation, and Classification
V. General Responsibilities Under the EAP
    A. Dam Owner Responsibilities
    B. Responsibility for Notification
    C. Responsibility for Evacuation
    D. Responsibility for Termination and Follow-Up
VI. Preparedness
VII. Inundation Maps
VIII. Appendices
    A. Investigation and Analyses of Dambreak Floods
    B. Plans for Training, Exercising, Updating and Posting the EAP
    C. Site-Specific Concerns
    D. Approval of the EAP

The suggested format was purposefully devised to separate an EAP into two distinct sections: The basic EAP and the Appendices which, when combined together, constitute a complete EAP.

1. The Basic EAP. Sections I through VII of the format constitute the basic EAP, i.e., they contain information that will likely be used by all parties (both the dam owner and emergency management officials) during an actual emergency. For example, the dam owner will use the notification flowchart to issue its emergency warning to the appropriate officials in a prioritized order. Similarly, the emergency management officials will use the flowchart to contact other officials or the dam owner, as needed, throughout the emergency. As a second example, both the dam owner and the emergency management officials will use the inundation maps extensively in fulfilling their responsibilities.

   It must be remembered that the responsibilities of the state and local emergency management authorities and other organizations in the jurisdictions affected by a dam failure or flooding as a result of operation of a dam are not included in an

EAP. Information unique to state and local emergency management authorities, and any other organizations that would have responsibilities for the warning and evacuation of populations at risk, would be included in the portion(s) of the appropriate jurisdiction's Emergency Operations Plan dedicated specifically to warning and evacuation of populations placed at risk as a result of dam failure or flooding due to large operational releases. However, the information in the EAP must be coordinated with the appropriate authorities because they will depend on and use the information in the dam owner's EAP to help them carry out their responsibilities.

NOTE: Every EAP must be tailored to site-specific conditions and to the requirements of the organization that owns, operates, or regulates the use of the dam. This can be accomplished under the suggested format. Uniformity of EAPs is important because any one state or local emergency management agency may be affected by a river system that has a series of dams, the independent failure or operation of which may impact the jurisdiction. Uniformity provides for clarity and better understanding of the information in the EAP for each individual dam.

The other basic elements and more on the Federal Guidelines for Dam Safety from the FEMA National Dam Safety Program is available at: http://www.fema.gov/fima/damsafe/eap_toc.shtm.

Appendix B

Reports Presented To or Used by the Task Force

The follow documents were used in the Black Water Task Force Report. Each entry is followed by information on whether the document can be found online or by requesting a copy from the authoring agency or the Environmental and Public Protection Cabinet.

Agency for Toxic Substances and Disease Registry (ATSDR), 2003a. Health Consultation. Martin County Coal Slurry Release. EPA Facility ID No. KYN000407233. Inez, Martin County, Kentucky. Division of Health Assessment and Consultation. 26 p. For more information, contact ATSDR at: 1-888-422-8737 or e-mail: atsdric@cdc.gov (public inquiries).

Agency for Toxic Substances and Disease Registry (ATSDR), 2003b. Toxicological Profile for Selenium. September 2003. 438 p. For more information, contact ATSDR at: 1-888-422-8737 or e-mail: atsdric@cdc.gov (public inquiries).

Barrick, R., S. Becker, L. Brown, H. Beller, and R. Pastorok, 1988. Sediment quality values refinement: 1988 update and evaluation of Puget Sound AET. Vol. 1. Prepared for the Puget Sound Estuary Program, Office of Puget Sound. A copy of the report's executive summary can be found at: http://uviclib.uvic.ca/archives/featured_collections/esa/mesc/abstracts_5_rc_pt2.html#rc5.2.1

Clean Air Task Force (CATF), 2001. Cradle to Grave: The Environmental Impacts from Coal. Boston, MA. June 2001. 8 p. A copy of the report can be found at: http://www.catf.us/publications/reports/Cradle_to_Grave.pdf

Jones, D.S., G.W. Suter, and R.N. Hull, 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 revision. Prepared for U.S. Dept of Energy, ES/ER/Tm-95/R4 48p. Nov. 6, 1997. A copy of the report can be found at: http://www.esd.ornl.gov/programs/ecorisk/documents/tm95r4.pdf

Lindsay, R.H., J.B. Hill, E. Gatain, R.C. Cooksey, R.L. Jolley, 1992. Antithyroid Effects of Coal-Derived Pollutants. Journal of Toxicology and Environmental Health 37(4):467-81. For reprints, contact the Taylor & Francis Group at 1-800-354-1420.

New Jersey Department of Environmental Protection (NJDEP), 1998. Guidance for Sediment Quality Evaluations. NJDEP. November. A copy of the report can be found at: http://www.state.nj.us/dep/srp/regs/sediment/

New York State Department of Environmental Conservation (NYSDEC), 1999. Technical Guidance for Screening Contaminated Sediments. January. A copy of the report can be found at: http://www.dec.state.ny.us/website/dfwmr/habitat/seddoc.pdf

Persaud, D., R. Jaagumagi, and A. Hayton, 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Water Resources Branch, Ontario Ministry of the Environment, Toronto, ONT, 27p. For more information, contact the Ontario Ministry of the Environment at: 1-800-565-4923

Pond, Greg, 2004. Effects of Surface Mining and Residential Land Use on Head-water Stream Biotic Integrity in the Eastern Coalfield Regions. Kentucky Division of Water. A copy of the report can be found at: http://www.water.ky.gov/NR/rdonlyres/ED76CE4E-F46A-4509-8937-1A5DA40F3838/0/Coal_Mining21.pdf

United States Geological Survey (USGS), 1999. Areas Susceptible to Irrigation-Induced Selenium Contamination of Water and Biota in the Western United States. U.S. Geological Survey Circular 1180. 38 p. A copy of the report can be found at: http://water.usgs.gov/nawqa/trace/pubs/circ1180.pdf

United States Geological Survey (USGS), 2001. Health Effects of Toxic Organic Compounds from Coal – The Case of Balkan Endemic Nephropathy (BEN). USGS Fact Sheet FS-004-01. 4 p. A copy of the report can be found at: http://pubs.usgs.gov/fs/fs004-01/fs004-01.pdf

West Virginia Geological & Economic Survey, 2002. Trace Elements in West Virginia Coals. Selenium. Last revised March 2, 2002. 2 p. A copy of this report can be found at: http://www.wvgs.wvnet.edu/www/datastat/te/SeHome.htm

The following documents were presented to the Black Water Task Force during task force meetings. Each entry is followed by information on whether the document can be found online or by requesting a copy from the authoring agency or the Environmental and Public Protection Cabinet.

Agency for Toxic Substances and Disease Registry (ATSDR), 2003. Health Consultation: Martin County Coal Slurry Release. Prepared by the Exposure and Consultation Branch, Division of Health Assessment and Consultation. EPA Facility ID No. KYN000407233. April 2003. Inez, Martin County, Ky. For more information, contact ATSDR at 1-888-422-8737 or e-mail: atsdric@cdc.gov (public inquiries).

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Kentucky Natural Resources and Environmental Protection Cabinet, 1984. Best Management Practices for Surface Coal Mining. Report prepared by the Division of Water. For more information, contact Maleva Chamberlain with the Division of Water at 502-564-3410.

McSpirit, S. and M. Dieckmann, 2003. Response and Technical Assessment. In response to: ATSDR Petitioned Health Consultation Public Comment Release. Report funded through the Appalachian Regional Commission and administered through Eastern Kentucky University, Richmond, Ky. A copy of the report can be found at: http://www.anthropology.eku.edu/MCSPIRIT/mcpt_ATSDR_cvr.htm

National Research Council, 2002. Coal Waste Impoundments: Risks, Responses, and Alternatives. Prepared by the Committee on Coal Waste Impoundments. National Academy Press, Washington, D.C. A copy of the report can be found at: http://www.nap.edu/books/030908251X/html/

ONDEO Nalco Company, 2004. Product reports on NALCO 9850 and OPTIMER® 83949 (both flocculants). For more information, contact Dana Norton at the Environmental and Public Protection Cabinet at 502-564-3350.

Pond, Greg. 2004 (unpublished). Water Quality Impacts From Coal Mining Releases. A presentation to the Black Water Task Force. April 8. For more information, contact Dana Norton at the Environmental and Public Protection Cabinet at 502-564-3350.

Potesta & Associates, Inc., 2001. Summary of Toxicity Testing Imitiated Following the Slurry Release from Martin County Coal Corporation. Prepared for Martin County Coal Corporation on May 18, 2001. Project No. 00-0340. For more information, contact Dana Norton at the Environmental and Public Protection Cabinet at 502-564-3350.

State of West Virginia, 2001. West Virginia Voluntary Remediation and Redevelopment Act: Guidance Manual Version 2.1. A copy of the report can be found at: http://www.dep.state.wv.us/item.cfm?ssid=18

U.S. Department of the Interior, 2003. Lexington Field Office Trend Analysis, November 2003. Prepared by the Office of Surface Mining. Report was intended for use only for informational purposes to indicate program trends. For more information, contact the OSM Lexington Field Office at 859-260-8400.